A BIOLOGICAL ASSESSMENT OF SITES IN THE DEARBORN RIVER DRAINAGE: LEWIS & CLARK COUNTY, MONTANA

Project TMDL-M12

August & September 2002

A report to

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by

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INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations.

This report summarizes data collected in August and September 2002 from sites in the Dearborn River drainage, Lewis and Clark County, Montana. Two sites were sampled on each of the following streams: the Dearborn River, the Middle Fork Dearborn River, and the South Fork Dearborn River. The study sites lie within the Montana Valley and Foothill Prairies ecoregion (Woods et al. 1999).

A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is "...a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region's natural environment..." (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "... an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition." (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1996). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998a). The first of these is an appropriate stratification or classification of stream sites, typically, by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied enhances the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat measures and the biotic metrics, in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998a) has recently studied the assemblages of the Montana Valleys and Foothill Prairies ecoregion, and has recommended a battery of metrics applicable to the valleys, foothills, and montane ecoregions of western Montana. This metric battery has been shown to be sensitive to impairment, related to measures of habitat integrity, and consistent over replicated samples.

METHODS

Samples were collected August 28-30 and September 10, 2002 by Montana DEQ personnel. Sample designations and site locations are indicated in Table 1a. In 2000, sites on both the Middle and South Forks of the Dearborn River were sampled (Bollman 2001). It was not possible to compare the results from that sampling to results from 2002, since the sampled sites were not identical between the 2 years.

The site selection and sampling method employed were those recommended in the Montana Department of Environmental Quality (DEQ) Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). The traveling-kick collection method was employed for all samples; duration and length are indicated in Table 1b. Aquatic invertebrate samples were delivered to Rhithron Associates, Inc., Missoula, Montana, for laboratory and data analyses. In the laboratory, the Montana DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with Montana DEQ protocols.

Table 1a. Sample designations and locations. Sites are listed in upstream-to-downstream order. Dearborn River drainage, August and September 2002.

Site	Station ID	Activity ID	Location Description	Latitude/ Longitude
DB1	M12DRBNR03	02-U335-M	Dearborn River upstream	47°16'47.3"/112°23'46.5"
DB2	M12DRBNR02	02-U332-M	Dearborn River downstream of Hwy 200	47°12'54.9"/112°14'27.4"
MF1	M12MFDBR01	02-UC206-M	Dearborn River- MF upstream	47°0'6.234"/112°0'21.294"
MF2	M12MFDBR02	02-UC207-M	Dearborn River- MF downstream of Rte. 434	47°12'37.4"/112°16'31.6"
SF1	M12SFDBR01	02-UC208-M	Dearborn River- SF upstream of bridge on Blacktail Ranch	47°7'15.2"/112°15'18.5"
SF2	M12SFDBR02	02-UC209-M	Dearborn River- SF upstream of Hwy 200 ½ mile	47°9'8.5"/112°13'36.2"

Table 1b. Sample collection procedure, duration, and length. Dearborn River drainage, August and September 2002.

Site	Date	Collection Procedure	Duration	Length
DB1	9-10-02	KICK	2:11 MINUTES	20 FEET
DB2	9-10-02	KICK	1:53 MINUTES	30 FEET
MF1	8-28-02	KICK	2:05 MINUTES	20 FEET
MF2	8-29-02	KICK	1:00 MINUTE	40 FEET
SF1	8-29-02	KICK	1:34 MINUTES	30 FEET
SF2	8-30-02	KICK	Not Recorded	Not Recorded

To assess aquatic invertebrate communities in this study, a multimetric index developed in previous work for streams of western Montana ecoregions (Bollman 1998a) was used. Multimetric indices result in a single numeric score, which integrates the values of several individual indicators of biologic health. Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment as expressed in water quality parameters or instream, streambank and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998a). The multimetric index used in this report incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics comprising the index, other metrics shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated

bioassessment score, however, since their performance in western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

The six metrics comprising the bioassessment index used in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998a). In addition, they are relevant to the kinds of impacts that are present in the Dearborn River drainage. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998a). Each of the six metrics developed and tested for western Montana ecoregions is described below.

1. **Ephemeroptera (mayfly) taxa richness.** The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.
2. **Plecoptera (stonefly) taxa richness.** Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.
3. **Trichoptera (caddisfly) taxa richness.** Caddisfly taxa richness has been shown to decline when sediment deposition affects their habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.
4. **Number of sensitive taxa.** Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998a).
5. **Percent filter feeders.** Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* spp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.
6. **Percent tolerant taxa.** Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others.

Scoring criteria for each of the six metrics are presented in Table 2. Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic

conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score, which is 18 for this metric battery.

The total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by Montana DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3b.

Table 2. Metrics and scoring criteria for bioassessment of streams of western Montana ecoregions (Bollman 1998a).

	Score			
Metric	**3**	**2**	**1**	**0**
Ephemeroptera taxa richness	> 5	5 - 4	3 – 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 – 5	5.01 - 10	10.01 – 25	> 25
Percent tolerant taxa	0 – 5	5.01 - 10	10.01 – 35	> 35

Table 3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis 1998).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

In this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality but were not incorporated into the bioassessment metric battery, either because they have not yet been tested for reliability in streams of western Montana, or because results of such testing did not show them to be robust at distinguishing impairment, or because they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment and heavy filamentous algae growth (Bollman 1998b). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998a). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).
- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity, and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.
- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.
- Number of "clinger" taxa. So-called "clinger" taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate "clingers" are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected "clinger" taxa richness in unimpaired streams of western Montana is at least 14 (Bollman 1998b).
- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman 1998b).

RESULTS

Habitat Assessment

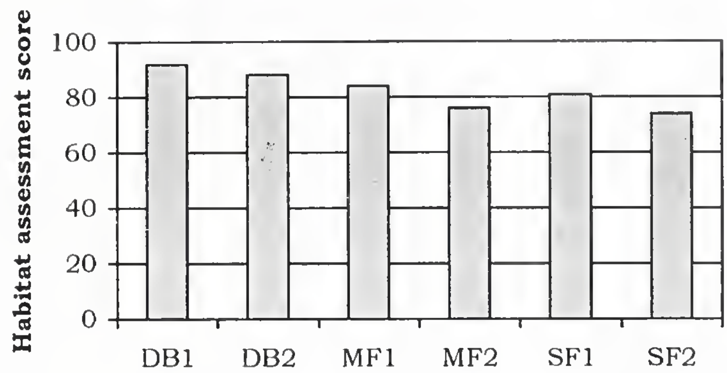
Table 4 shows the habitat parameters evaluated, parameter scores and overall habitat evaluations for the 6 sites studied. Figure 1 graphically compares total habitat assessment scores for these sites.

Table 4. Stream and riparian habitat assessment. The 6 sites in the Dearborn River drainage were assessed based upon criteria developed by Montana DEQ for streams with riffle/run prevalence. August and September 2002.

Max. possible score	Parameter	DB1	DB 2	MF1	MF2	SF1	SF2
10	Riffle development	10	9	10	9	10	8
10	Benthic substrate	9	9	8	9	8	8
20	Embeddedness	19	18	19	15	15	11
20	Channel alteration	20	18	19	15	20	17
20	Sediment deposition	19	15	15	11	11	12
20	Channel flow status	18	18	10	16	16	19
20	Bank stability	10 / 10	9 / 9	9 / 9	6 / 9	9 / 7	9 / 9
20	Bank vegetation	6 / 8	9 / 7	9 / 9	7 / 8	9 / 9	9 / 9
20	Vegetated zone	9 / 10	10 / 10	9 / 9	8 / 8	8 / 8	4 / 4
160	Total	148	141	135	121	130	119
	Percent of maximum	**92%**	**88%**	**84%**	**76%**	**81%**	**74%**
	CONDITION*	**OPTIMAL**	**OPTIMAL**	**OPTIMAL**	**SUB-OPTIMAL**	**OPTIMAL**	**SUB-OPTIMAL**

Condition categories: Optimal > 80% of maximum score; Sub-optimal 75 - 56%; Marginal 49 - 29%; Poor <23%. (Plafkin et al. 1989).

Figure 1. Total habitat assessment scores for six sites in the Dearborn River drainage, August and September 2002.



Habitat scores generally diminished from upstream sites to downstream sites on all three streams. Condition at Sites DB1 and DB2, MF1, and SF1 were all judged optimal; conditions at Sites MF2 and SF2 were judged sub-optimal.

At the upper site on the Dearborn River (DB1), instream and riparian zone parameters scored optimally. Streambank vegetation exhibited some disruption; however, streambanks were perceived to be stable. At the downstream site (DB2), fine sediment deposition and some disruption of streambank vegetation were noted.

On the Middle Fork Dearborn River, flow conditions at the upstream site (MF1) were judged marginal. Benthic substrate particle sizes were apparently less diverse than expected. Streambank parameters all scored optimally. At the lower site (MF2), fine sediment deposition was reported, and streambanks were only moderately stable, with some disruption to vegetation on the left side of the channel.

At the upstream site on the South Fork Dearborn River (SF1), field personnel noted that fine sediments covered and surrounded benthic substrates. Diversity of particle sizes was less than expected. Streambanks were only moderately stable on the right side of the channel. Downstream, site SF2 was also affected by fine sediment deposition and embedded substrates. The riparian zone width at this site was abbreviated.

Bioassessment

Table 5 itemizes each contributing metric and shows individual metric scores for each site. Figure 2 summarizes bioassessment scores for aquatic invertebrate communities sampled at the 4 sites in this study. Tables 3a and 3b above show criteria for use-support categories recommended by Montana DEQ (Bukantis 1998) and impairment classifications (Plafkin et al. 1989).

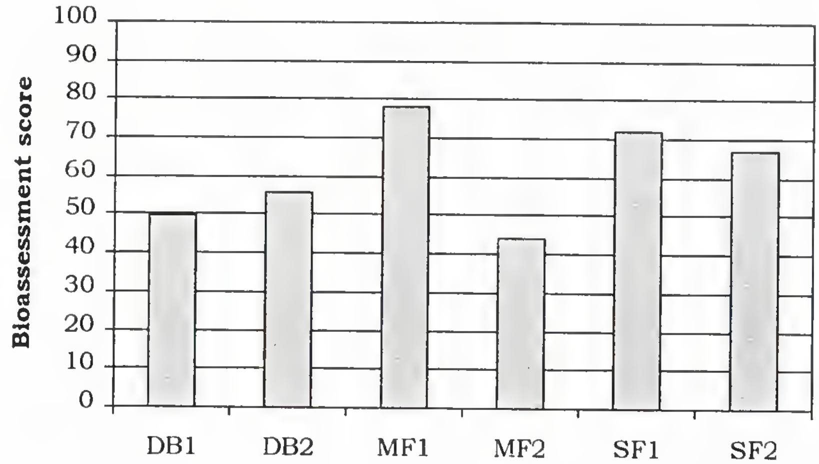
When this bioassessment method is applied to these data, scores suggest that there was slight to moderate impairment of biotic integrity at the sites studied. Full support of designated uses was attained at the upper site on Middle Fork Dearborn River. All other assessed sites only partly supported uses. Assessment was rendered unreliable by inadequate numbers of organisms in samples taken from both sites on the Dearborn River.

Table 5. Metric values, scores, and bioassessments for sites in the Dearborn River drainage, August and September 2002. Site locations are given in Table 1. The revised Montana Valley and Foothill Prairies bioassessment method (Bollman 1998a) was used to calculate scores.

	SITES					
METRICS	**DB1**	**DB2**	**MF1**	**MF2**	**SF1**	**SF2**
	METRIC VALUES					
Ephemeroptera richness	6	7	9	4	7	5
Plecoptera richness	3	4	5	2	2	4
Trichoptera richness	2	2	4	5	9	8
Number of sensitive taxa	1	1	5	0	2	0
Percent filterers	20.69	18.83	1.74	39.42	7.89	4.11
Percent tolerant taxa	8.05	29.15	36.11	34.62	20.72	14.38
	METRIC SCORES					
Ephemeroptera richness	3	3	3	2	3	2
Plecoptera richness	2	3	3	2	2	3
Trichoptera richness	1	1	2	3	3	3
Number of sensitive taxa	1	1	3	0	2	0
Percent filterers	0	1	3	0	2	3
Percent tolerant taxa	2	1	0	1	1	1
TOTAL SCORE (max.=18)	9	10	14	8	13	12
PERCENT OF MAX.	**(50%)**	**(56%)**	**78%**	**44%**	**72%**	**67%**
Impairment classification*	**(MOD)**	**(SLI)**	**SLI**	**MOD**	**SLI**	**SLI**
USE SUPPORT †	**(PART)**	**(PART)**	**FULL**	**PART**	**PART**	**PART**

* Impairment classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.
† Use support designations: See Table 3a.

Figure 2. Comparison of total bioassessment scores (reported as percent of maximum score) for sites in the Dearborn River drainage August and September 2002. The revised Montana Valley and Foothill Prairies bioassessment method (Bollman 1998a) was used to calculate scores.



Aquatic invertebrate communities

Interpretations of biotic integrity in this report are made without reference to results of habitat assessments, or any other information about the sites or watersheds that may have accompanied the invertebrate samples. Interpretations are based entirely on: the taxonomic and functional composition of the sampled invertebrate assemblages; the sensitivities, tolerances, physiology, and habitus information for individual taxa gleaned from the writer's research, the published literature, and other expert sources; and on the performance of bioassessment metrics, described earlier in the report, which have been demonstrated to be useful tools for interpreting potential implications of benthic invertebrate assemblage composition.

The Dearborn River assemblages

At the upper site on the Dearborn River (DB1), sampling efforts yielded only 87 animals, too few to obtain reliable results from this bioassessment method. The sample collected at the lower site (DB2) also contained fewer invertebrates (223) than expected, though animals were not nearly so scarce at this site compared to the upper site. Field notes suggest that the sites were vigorously sampled, making it seem unlikely that inadequate effort was to blame for the paucity of organisms collected. Rapid or scouring flow conditions may account for small sample sizes; but no information to that effect was provided. Absent scouring flows, low abundances of benthic invertebrates may be due to habitat disturbances or to chronic or acute water quality degradation. Since habitat assessment did not arouse suspicion of severely disturbed habitat, water quality problems seem to be the more likely explanation for the inadequate samples. The taxonomic composition of the sampled assemblages suggests that acute impacts without lingering water quality effects cannot be ruled out. Sensitive and long-lived animals were collected at both sites, and mayfly taxa richness was high at both locations. Although speculative, it is reasonable to suggest that a pulse of pollutants or suspended sediments may have been introduced into the Dearborn River, resulting in temporary water quality impairment and loss of benthic life. Dewatering in the recent past could be an alternative hypothesis. Re-colonization after such events may perhaps still be in progress. At the upper site (DB1), the low biotic index value (2.25) and the

mayfly taxa richness (6), which was high in spite of the low sample size, suggest that water quality was good at the time of sampling. Interpretation of indicators of habitat quality is not possible with the information at hand.

While the sample size was smaller than expected, some information can be extracted from the invertebrate assemblage collected at the lower site on the Dearborn River (DB2). Although mayfly taxa richness (7) was within expectations for a foothill stream, the biotic index value (4.14) was higher than expected. The fauna included taxa that prefer warmer water temperatures, such as the mayfly *Tricorythodes minutus*, and several snail taxa. Only a single individual in a cold-stenothermic taxon was collected; this was the mayfly *Drunella doddsi*. These findings support a hypothesis that warm water temperatures exerted influence over the composition of the benthic assemblage at this site. There may have also been mild nutrient enrichment here.

Twelve "clinger" taxa made up over half of the sampled organisms. While both the "clinger" richness and the caddisfly richness were lower than expected, the abundance of both suggests that fine sediment deposition did not significantly limit the availability of hard benthic substrates for colonization. Other instream habitats appear to have been abundant; taxa richness was high (40) and the contribution of predators (12 taxa, 21% of the sampled organisms) to the functional mix was ample. Four stonefly taxa were present, implying that reach-scale habitat features such as streambanks, channel morphology, and riparian zone function were essentially intact. At least 7 long-lived taxa were supported at the site, which suggests that surface flow was uninterrupted during the year, and that no other catastrophes recently occurred that would limit long life cycles. All expected components contributed to the functional mix, although shredders were underrepresented.

Middle Fork Dearborn River assemblages

Good water quality is implied by the composition of the assemblage sampled at the upper site on the Middle Fork (MF1). The biotic index value (3.58) was within expectations for riverine environs, and the mayfly fauna (9) was rich in taxa. The site supported no fewer than 6 cold-stenothermic taxa, including the stoneflies *Yoraperla* sp. and *Megarcys* sp. Cold, clean water appears to have provided the matrix for a sensitive, balanced invertebrate assemblage.

Sixteen "clinger" taxa were collected, but the caddisfly fauna was limited to 4 taxa, none of which was abundant. "Clingers" accounted for 37% of the sampled animals; it seems likely that, despite the scarcity of caddisflies, fine sediment deposition did not alter stony substrates excessively. Eight predator taxa were collected, and overall taxa richness was high (30 taxa). These findings suggest that diverse and abundant habitats were available at the site. Reach-scale habitat features were probably minimally disturbed, since 5 stonefly taxa appeared in the sample. Only 2 long-lived taxa were collected; periodic dewatering or other catastrophic events cannot be ruled out. All expected functional components were present, but the contribution of shredders was less than expected; hydrologic conditions may not have favored retention of large organic debris, or perhaps riparian inputs of such material were limited.

At the downstream site on the Middle Fork, the collected assemblage yielded a high biotic index value (5.43), and mayfly taxa richness (4) was limited. Chironomids made up more than half of the sampled animals. Not a single sensitive taxon was collected. These findings suggest that mild-to-moderate enrichment may have affected the benthic invertebrate community at this site. Warm water temperatures are indicated by the presence of the caddisflies *Helicopsyche borealis* and *Hydroptila* sp., and the hemoglobin-bearing midge *Microtendipes* sp.

Only 11 "clinger" taxa were collected, but these taxa made up 58% of the sampled animals. Their abundance and the presence of at least 5 caddisfly taxa make it seem likely that fine sediment deposition did not substantially alter the availability of stony substrate surfaces for colonization. Other types of instream habitats appear to have been abundant as well, since taxa richness was high (35) and the site supported at least 8 predator taxa. Fewer stonefly taxa than expected were present, suggesting that

reach-scale habitat features may have been altered from natural condition. Such features may include streambank integrity, channel morphology, or riparian zone function. Semi-voltine taxa were abundant, although only 4 taxa were collected. It seems unlikely that dewatering or other devastations to aquatic life cycles occurred recently. All expected functional components were present, though shredders seem to have been scarcer than expected. Shredders depend on ample supplies of large organic debris from the riparian zone, and hydrologic conditions suited to the retention of this material. The large contribution of filter-feeders seems entirely appropriate for riverine environs.

South Fork Dearborn River assemblages

At the upstream site on the South Fork, the biotic index value (4.06) calculated for the benthic assemblage was slightly higher than expected. On the other hand, 7mayfly taxa were collected; thus, the water quality indicators give contrary results for this sample. Since 45% of sampled organisms were midges, it is possible that mild nutrient enrichment affected the invertebrate fauna here. A few cold-stenotherms appeared in the sample, but none were abundant. Water temperatures were probably not warm.

Only 2 stonefly taxa were taken in the sample. Stonefly richness may be associated with the integrity of reach-scale habitat features such as streambank stability, natural channel morphology, or riparian zone function. The dearth of stonefly taxa at this location could indicate disruption of these features. However, instream habitats appear to have been unimpaired. Twenty “clinger” taxa were present in the sample, and caddisfly richness (9) was high. “Clingers” and caddisflies are associated with clean stony substrates, uncontaminated by fine sediment deposition. High taxa richness (35) and high predator richness (10 taxa) suggest that instream habitats were diverse and plentiful. At least 5 long-lived taxa were present at the site, indicating perennial surface flow. Functionally, the assemblage was skewed toward collectors, which represented 79% of sampled organisms. Both shredders and scrapers were scarce. This functional mix supports a hypothesis that mild nutrient enrichment could have slightly impaired biotic integrity here.

At the lower site on the South Fork, the biotic index value (6.01) was the highest calculated for any site in this study. Mayfly taxa richness (5) was somewhat depressed. No sensitive taxa were collected, and 68% of sampled organisms were midges. These findings suggest that nutrient enrichment may have compromised biotic integrity at this site.

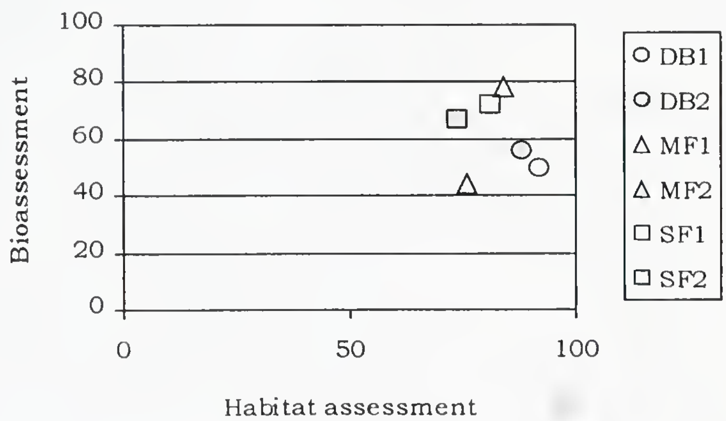
The presence of 18 “clinger” taxa and 8 caddisfly taxa imply that fine sediment deposition did not obliterate clean stony substrates. Other habitats were probably not compromised either, since at least 38 invertebrate taxa, including 6 predatory taxa, were supported at the site. Disruption of reach-scale habitat features seems unlikely, since 4 stonefly taxa, including the salmonflies *Pteronarcella badia* and *Pteronarcys* sp., were collected. It appears that there were no recent catastrophes such as dewatering here, since 7 semi-voltine taxa were among those taken in the sample. The functional mix was overwhelmed by collectors, which concurs with the hypothesis of nutrient enrichment.

CONCLUSIONS

- Inadequate sample size limits the information pertaining to habitat quality at the upstream site on the Dearborn River (DB1). Taxonomic composition of the small sample suggests that water quality was essentially good, but that temperatures may have been warm.
- Warm water temperatures and possibly mild enrichment are suggested by the composition of the sample taken at the downstream site (DB2) on the Dearborn River.

- Good water quality and intact habitat were indicated by the invertebrate assemblage collected at the upper site on the Middle Fork (MF1). Seasonal dewatering could not be ruled out.
- At the downstream site on the Middle Fork (MF2), mild-to-moderate nutrient enrichment is suggested by the taxonomic composition of the sampled organisms. Reach scale disturbances may also be indicated by faunal components.
- Mild nutrient enrichment may have affected the benthic assemblage at the upper site on the South Fork (SF1). Reach scale disturbances may also be present.
- At the downstream site on the South Fork (SF2), nutrient enrichment is suggested by the taxonomic and functional composition of the invertebrate community.
- Figure 3 plots bioassessment scores against habitat scores. Symbols representing both Dearborn River sites (DB1 and DB2) and the downstream site on the Middle Fork (MF2) lie in the area of the graph suggesting that water quality impairment was more influential than habitat degradation in limiting biotic health.
- The bioassessment method applied to these data was developed for 2nd, 3rd, and 4th order streams; certain limitations are apparent when the method is applied to riverine environs. In particular, the metrics Percent Filterers and Percent Tolerant Taxa appear to overestimate impairment in riverine systems. Further study is recommended to obtain calibration of metrics for larger waterways. It is likely that the sites studied here were less impaired than scores presented here suggest.

Figure 3. Total bioassessment scores plotted against habitat assessment scores for 6 sites in the Dearborn River drainage, August and September 2002. (after Barbour and Stribling 1991).



LITERATURE CITED

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